

Task 4

Development & Screening of Flood Mitigation Alternatives

City of Allen Park

City of Dearborn Heights

City of Ecorse

City of Inkster

City of Lincoln Park

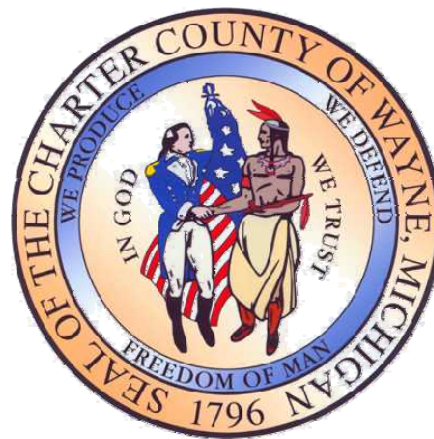
City of Melvindale

City of Taylor

City of Romulus

City of Westland

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TASK 4 – DEVELOPMENT AND SCREENING OF FLOOD MITIGATION ALTERNATIVES

Introduction

The objective of Task 4 of the flood control study of the North Branch of the Ecorse Creek Drain (NBECD) is to consider all ideas for flood mitigation measures and complete an initial screening. Flood mitigation measures must (a) reduce peak flood flow rates; (b) reduce runoff volumes; (c) increase flood conveyance; and/or (d) detain flood flows. The initial screening of mitigation measures was completed to prioritize measures that should be evaluated in detail and avoid expending effort analyzing measures that could be determined not viable using simple initial screening criteria.

Mitigation measures determined to meet initial screening criteria would be later evaluated in Tasks 5 and 6 in greater detail, including computer modeling, flood mapping, and cost estimating. Task 4 summarizes the efforts made to develop and screen flood mitigation measures.

Technical and Policy Committees

In developing the flood control study, WCDOE facilitated the formation of the Technical Committee and Policy Committee. The committees consist of representatives from each of the nine municipalities in the NBECD drainage district, MDOT, WCDOE, USACE and members of the flood control study consultant team. For the duration of the flood control study, a total of twelve (12) committee meetings were conducted. The minutes of these meetings are available from WCDOE.

The purpose of the Technical Committee was to assist in the development and review of flood mitigation alternatives, provide information regarding local conditions, and provide input regarding impacts to local infrastructure. Members of this committee included technical advisors from each of the municipalities, WCDOE, MDOT and the USACE.

The purpose of the Policy Committee was to provide input to WCDOE regarding local acceptability, advise WCDOE in the development of flood mitigation alternatives, and share information with councils, constituents, or other members of the organization. The Policy Committee included mayors or their representatives from each of the municipalities and advisors from WCDOE, MDOT and the USACE.

Development of Potential Mitigation Measures

Potential mitigation measures are defined as individual actions that offer the possibility of reducing peak flow rates, runoff volumes, increasing flood conveyance or detaining flood flows. The identification of these mitigation measures was a coordinated effort between the consultant team, the WCDOE, the Technical Committee and the Policy Committee.

Initially, the consultant team researched and developed a list of mitigation measures. The initial list included the mitigation measures presented by the USACE in their 1988 Feasibility Report for Flood Protection in the Ecorse Creek Drainage Basin, mitigation measures presented by the Ecorse Creek Inter-Municipality Watershed Committee in the 2005 draft Watershed Management Plan, and ideas for mitigation measures developed by the consultant team.

The initial list of mitigation measures was reviewed with the WCDOE management staff and was updated based on their input. The updated list of mitigation measures was then presented to the Technical Committee at the June 30, 2005 meeting. Past recommendations, new ideas, and perceived problems were also discussed with the Technical Committee representatives at the September 1, 2005 and October 22, 2005 meetings. Therefore, the initial list of mitigation measures was refined based on input from the Technical Committee.

The updated list of mitigation measures was then presented to the Policy Committee at meetings on March 1, 2006, May 22, 2006, and December 14, 2006. Based on input from the Policy Committee, additional items were added to the list.

Table 4-1 provides a summary of mitigation measures that were identified and were considered for initial screening of viable flood mitigation measures. Again, in the development of this list, all ideas were considered and the purpose of initial screening was to identify which measures were viable for detailed analysis to be completed in Tasks 5 and 6.

**Table 4-1
Ideas for Potential Mitigation Measures
For Flood Control in the NBECD**

Channel Improvements	<ul style="list-style-type: none"> - Trapezoidal vegetated channel - Restore previous design, trapezoidal vegetated channel - Greenway channel - Concrete lined channel - Enclosed channel
Crossing Improvements	<ul style="list-style-type: none"> - Clean sediment and debris from crossings - Removal of crossings - Replacement of crossings - Allowed overtopping of crossing
Storm Water Detention	<ul style="list-style-type: none"> - Thirty potential sites for storm water detention (see Table 4-4)
Diversions / Drainage Transfers	<ul style="list-style-type: none"> - Divert NBECD to Rouge River along I-94 - Divert LeBlanc Drain to NBECD at Monroe Street - Divert Reeck Drain to NBECD at Monroe Street - Allow overflow of NBECD to the City of Dearborn storm sewers - Divert NBECD to Huron River
Storm Water Tunnels	<ul style="list-style-type: none"> - Tunnel diversion along lower reach NBECD - Tunnel to divert NBECD to Rouge River - Tunnel diversion under Van Born Road in middle reach of NBECD
Floodplain Management	<ul style="list-style-type: none"> - Acquire existing undeveloped lands in flood plain - Acquisition of flood prone structures - Vegetative and wetland buffers along drain corridor - Acquire and create new floodplain storage along NBECD corridor

Storm Water BMPs	
County and Local Ordinances	<ul style="list-style-type: none"> - Rain gardens - Infiltration basins - Porous pavement roads and driveways - Catch basin restrictions - Ditch and swale drainage standard - Drainage system maintenance (basins, drain and culvert cleaning) - Land use ordinance - Disconnect roof drains - Open space preservation - Natural features protection/buffers - Rain barrels - Public education
New/Redevelopment with County Storm Water Ordinance	
Retrofit publicly owned detention basins and other public areas, including parking lots	
Wide spread retrofitting of private developments	

Initial Screening of Potential Mitigation Measures

All ideas presented were placed on the initial list of potential flood mitigation measures. Initially, all potential mitigation measures were assumed to be technically viable. Upon final development of the list, measures were evaluated against initial screening criteria and alternatives that were not viable were eliminated. The initial screening of mitigation alternatives considered (a) acceptability by local government, (b) ability to implement, (c) cost effectiveness, (d) level of service, (e) preliminary engineering analysis, and (d) preliminary environmental assessment. The following paragraphs discuss the criteria in further detail.

Local Acceptability

The mitigation measures and flood mitigation alternatives must be acceptable on a local governmental level. The Technical and Policy Committees, along with WCDOE, identified the mitigation measures that would not be socially acceptable. The following mitigation measures were determined not acceptable:

- An alternative that includes only acquisition of flood prone property (too many properties and too costly of an alternative).
- No action alternative (too much history of large scale flooding in an urbanized area).
- Discharge of NBECD storm water into adjacent municipal storm, combined or sanitary sewer systems (no additional capacity, increased flow to treatment facilities and possible sewage overflows).
- Reconstruction of the NBECD as a concrete lined channel (too expensive and not environmentally acceptable).

- Enclosure of the NBECD (too expensive and not environmentally acceptable).
- Diversion of storm water to the Huron River (too expensive and adverse environmental impacts).

Ability to Implement

The Director of the WCDOE also serves as the Wayne County Drain Commissioner. In Michigan, the Drain Commissioner oversees the maintenance and improvements of county drains in accordance with the Michigan Drain Code (P.A. 40 of 1956). In August 2006, the Drain Commissioner was petitioned for improvements on behalf of the NBECD Drainage District for flood relief. As a result of the petition a Board of Determination (BOD) was convened and on December 15, 2004 to hear public testimony regarding existing flooding problems. Based on testimony, the BOD ordered the Drain Commissioner to make improvements to provide relief of existing flooding problems, thus providing the Drain Commissioner the ability to implement a flood control project per the Michigan Drain Code. The initial implementation step is the completion of this flood control study.

A review of the ability of the Drain Commissioner to implement the potential mitigation measures listed in Table 4-1 was completed. Based on this review, it was identified that most of the mitigation measures, with the exception of storm water BMPs could be implemented as part of the flood control project. County and local government can implement many of the BMP's through local ordinances and watershed planning efforts.

This is recommended, but not considered an integral mitigation measure for the flood

control study, with the exception of adherence to the Wayne County Storm Water Ordinance. Implementation of rules and regulations put forth in the Wayne County Storm Water Ordinance is paramount in the proper management of the watershed and a baseline assumption of the study. Task 2 outlines the inclusion of this BMP as part of the flood control study.

The storm water BMP of maintenance of the drains, both county and municipal, was also identified and is necessary. The Drain Commissioner has jurisdiction to complete maintenance on county drains and has been doing so. The individual municipalities are responsible for maintenance of their drains. The Michigan Drain code limits the Drain Commissioner to an annual expenditure of \$2,500 per mile for maintenance of county drains. Due to legal limitations of the Michigan Drain Code and the extent of improvements needed for flood mitigation, drain maintenance alone has been considered a non-viable alternative for flood mitigation along the NBECD.

The remaining listed storm water BMP's are recommended and are beneficial to the overall objective of this flood control study; however, they were identified to be beyond the ability of the Drain Commissioner to implement on behalf of (and at the expense of) the NBECD Drainage District and therefore were not evaluated in detail as part of the flood control study.

Cost Effectiveness

The WCDOE and the Technical Committee identified that cost effectiveness is extremely critical; however, for the initial screening phase it was determined that potential mitigation measures should not be disqualified from consideration based on cost alone. Mitigation measures that met all other initial screening criteria could be considered for detailed analysis, even if initial screening suggested a measure may cost more. Measures that possibly had greater social acceptance, environmental benefit or lower impact construction methods were not to be disqualified in initial screening based on opinions of cost alone. As part of Tasks 5 and 6, cost benefit and effectiveness was evaluated in detail. Task 6 includes a comprehensive evaluation matrix to assist in the final selection and recommendation of a flood mitigation plan. The Task 6 report should be reviewed for detailed information regarding cost effectiveness and cost benefit.

Level of Service

The WCDOE identified that a flood control project must provide a minimum level of service (level of protection) to mitigate flooding for the 10 year design storm. In Michigan, this is the typical design standard for county drainage systems. Task 2 provides hydrologic and rainfall data and a definition for the 10 year design storm. It is recognized that mitigation measures must not meet the required level of service individually; rather combination of mitigation measure into a flood mitigation alternative or flood control project must meet this level of service.

Preliminary Engineering Analysis

Preliminary and basic engineering calculations were completed for initial screening of potential mitigation measures. The purpose was to develop a general understanding of the level of service and the viability of each of the potential mitigation measures. Viable mitigation measures were prioritized for further analysis, computer modeling and evaluation. Computer modeling and analysis of existing, baseline and improved conditions are outlined in Tasks 2 and 3 and computer modeling and analysis of flood mitigation alternative are outlined in Tasks 5 and 6. The preliminary analysis and calculations completed for Task 4 are not intended to provide detailed results; they are for planning and screening purposes only. Preliminary calculations were conducted to assess:

- Channel improvements
- Crossing improvements
- Storm water detention facilities
- Diversions / drainage transfers
- Tunnels
- Floodplain management

Results from these calculations are discussed below.

Channel Improvements

Channel improvement mitigation measure ideas that were identified included:

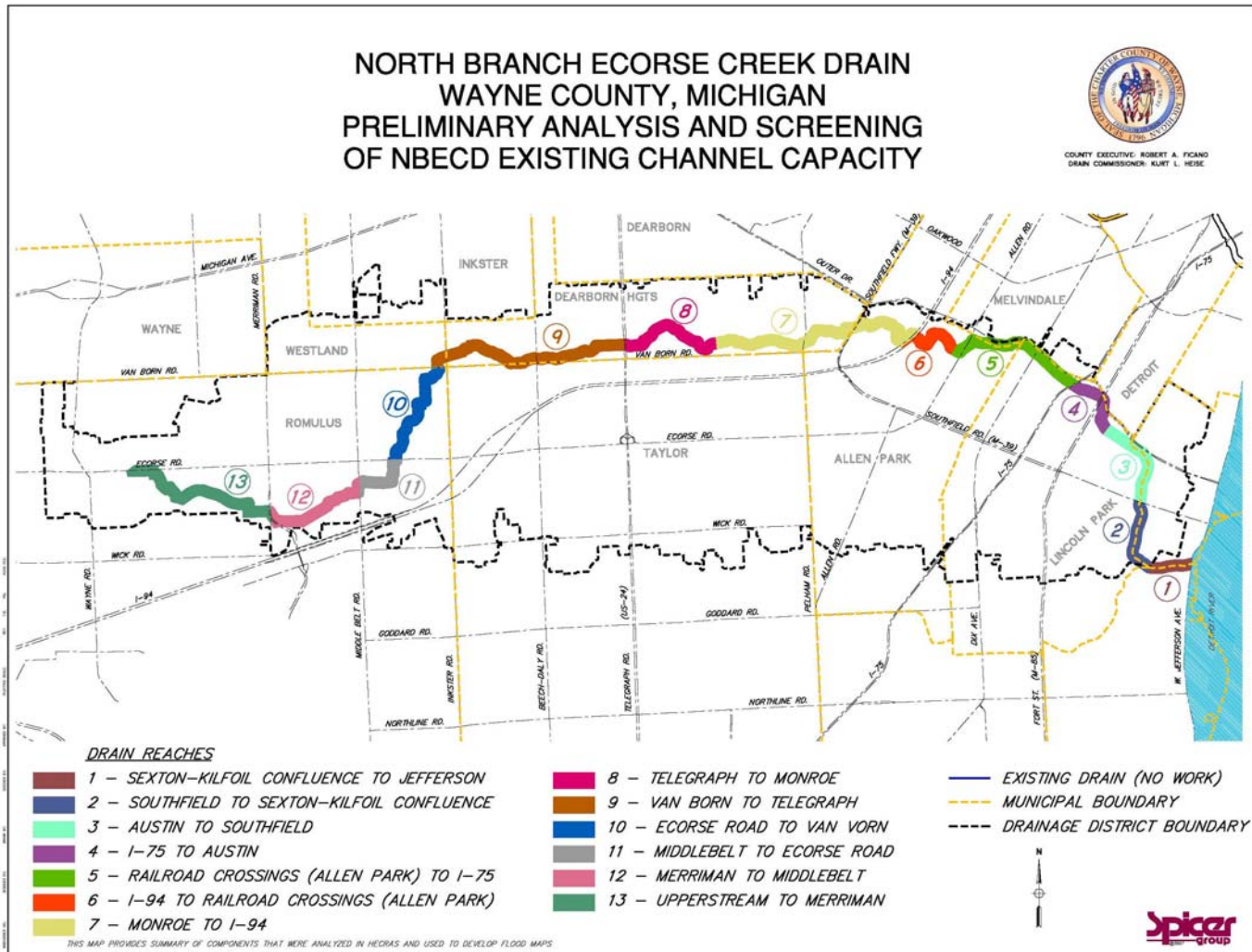
- Trapezoidal vegetated channel
- Restore previous design, trapezoidal vegetated channel

- Greenway channel
- Concrete lined channel
- Enclosed channel

As previously mentioned, a concrete lined channel and an enclosed channel were eliminated as potential mitigation measures as they are not accepted by local governments as viable measures.

The initial screening for the remaining potential channel improvements, including a comparison of the approximate bank full capacity of the existing channel with the published FEMA flow rates and the original (1948) design flow rates, was completed. In order to do so, the NBECD was divided into thirteen (13) reaches, see Figure 4-1. Each reach was assigned a typical cross section based on the survey data collected in Task 2. The approximate existing bank full flow capacity for each reach, the flow rates from FEMA Flood Insurance Studies (10 year and 100 year flood flow rates), and the 1948 design unit capacities are shown in Table 4-2.

Figure 4-1
Reaches of NBECD



**Table 4-2
Preliminary Analysis and Screening
of NBECD Existing Channel Capacity**

Reach No.	Description	Estimated Bank Full Capacity (cfs)	10 Year Flood Flow Rate from FIS (cfs)	100 Year Flood Flow Rate from FIS (cfs)	Tributary Drainage Area (acres)	Existing Unit Capacity (cfs/acre)	1948 Design Unit Capacity (cfs/acre)
1	Sexton-Kilfoil Confluence to Jefferson	2,300	3,165	4,410	19,210	0.120	**
2	Southfield to Sexton-Kilfoil Confluence	950	1500	2,100	15,328	0.051	0.09
3	Austin to Southfield	1,000	980/1,500	1,480/2,100	14,609	0.055	0.09
4	I-75 to Austin	600	980	1,480	14,072	0.034	0.09 / 0.07
5	Railroad Crossings (Allen Park) to I-75	350	**/960	7,15/1,490	8,498	0.029	0.07
6	I-94 to Railroad Crossings (Allen Park)	250	**	715	8,498	0.021	0.07
7	Monroe to I-94	450	**	775/715	7,168	0.042	0.07
8	Telegraph to Monroe	400	**	1,300	6,921	0.047	0.07
9	Van Born to Telegraph	350	495/760/815	1,160/1,430/1,370	3,961	0.088	0.09
10	Ecorse Road to Van Born	125	**	**	2,115	0.059	**
11	Middlebelt to Ecorse Road	300	***	***	1,902	0.158	**
12	Merriman Road to Middlebelt	200	***	***	1,265	0.158	**
13	Upstream of Merriman	90	***	***	1,086	0.083	**

* Design unit capacities are based on a letter to the Wayne County Drain Commissioner dated September 3, 1948.

** Data not available

*** No FIS

Table includes entire drain length, except for long enclosure near Merriman Road.

Table 4-2 shows that the existing channel does not have the capacity to convey the flow identified in the FEMA Flood Insurance Study (FIS) or the unit capacity from the 1948 design. The 1948 design is represented by unit flow rate per acre. The unit capacity rate

is the flow generated from one acre of contributing land. The design unit capacity is therefore, the maximum runoff that can be generated from one acre of contributing land without overtopping the drain banks.

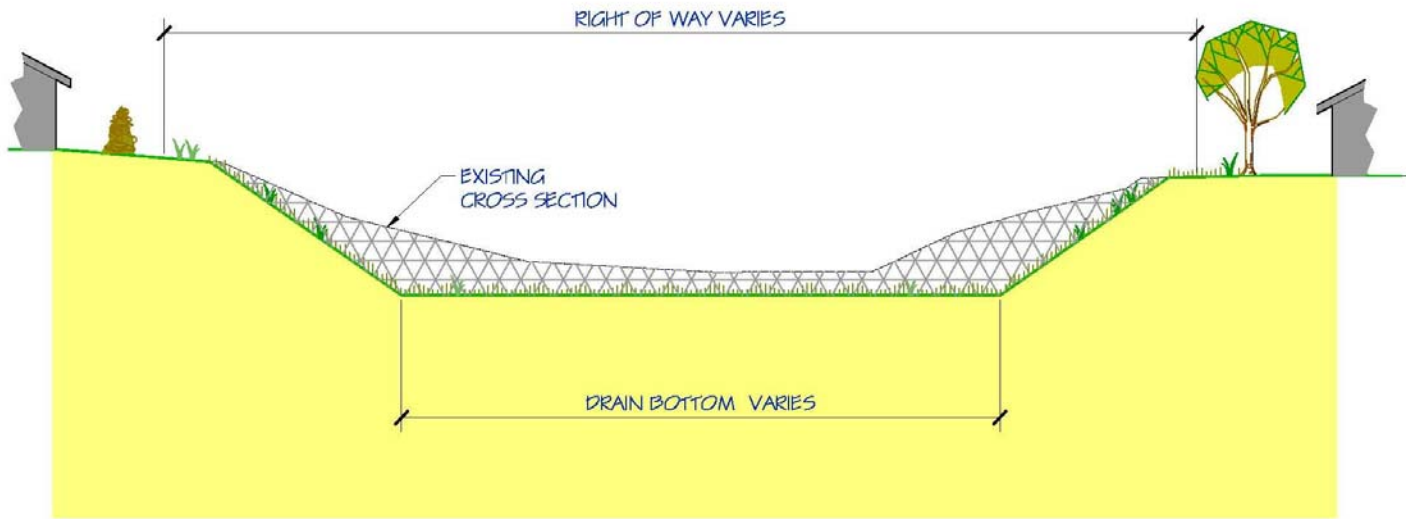
The unit capacity for the 1948 design ranged from 0.07 to 0.09 cfs per acre, which is approximately half of the current 10 year design storm unit discharge rate outlined in the Wayne County Storm Water Ordinance of 0.15 cfs/acre. Furthermore, the 0.15 cfs/acre from the ordinance applies only to sites that have on-site storm water detention. Since the majority of the drainage district was developed prior to the adoption of the ordinance, the large majority of the development in this drainage district does not have on-site storm water detention, thus a unit discharge of greater than 0.15 cfs/per acre for the 10 year design storm will occur.

The preliminary calculations show that the flooding along the NBECD is attributed to inadequate conveyance capacity in the existing channel. The calculations also show that restoring the channel to the 1948 design capacity will not provide the 10 year level of service and that channel improvements to increase conveyance capacity must be an integral part of any viable flood mitigation alternative.

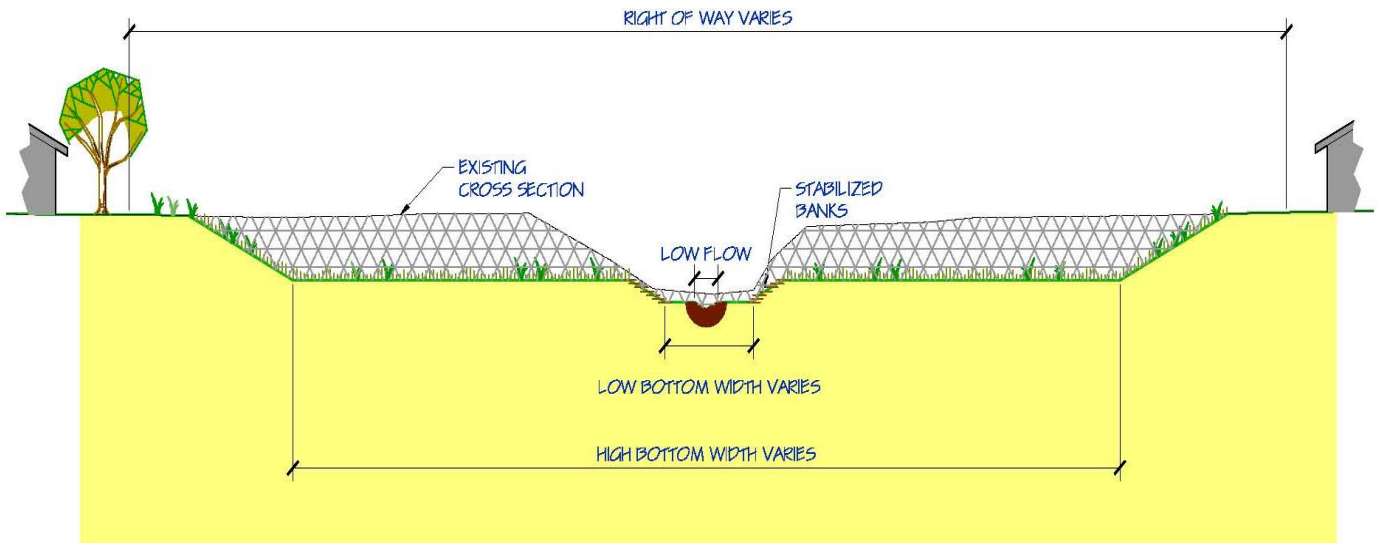
It was determined that channel improvements must be evaluated in detail. The following typical channel improvement mitigation measures were determined to be acceptable:

- Trapezoidal open channel with vegetated slopes (see Figure 4-2)
- A greenway channel with vegetated slopes (see Figure 4-3)

**Figure 4-2
Trapezoidal Open Channel**



**Figure 4-3
Greenway Channel**



Crossing Improvements

Crossing improvement mitigation measures that were identified included:

- Clean sediment and debris from crossings
- Removal of crossings
- Replacement of crossings
- Allowed overtopping of crossing

Bridge and culvert (drain) crossings along the NBECD were surveyed. A total of 81 drain crossings existed along the NBECD at the time of the survey. A list of the crossing locations, types and open waterway areas is provided in Task 2.

Removal of sediment from the drain crossing was assumed as a baseline condition as outlined in Task 3. As shown in Task 3, removal of sediment at drain crossings as a stand alone mitigation measure does not achieve flood mitigation.

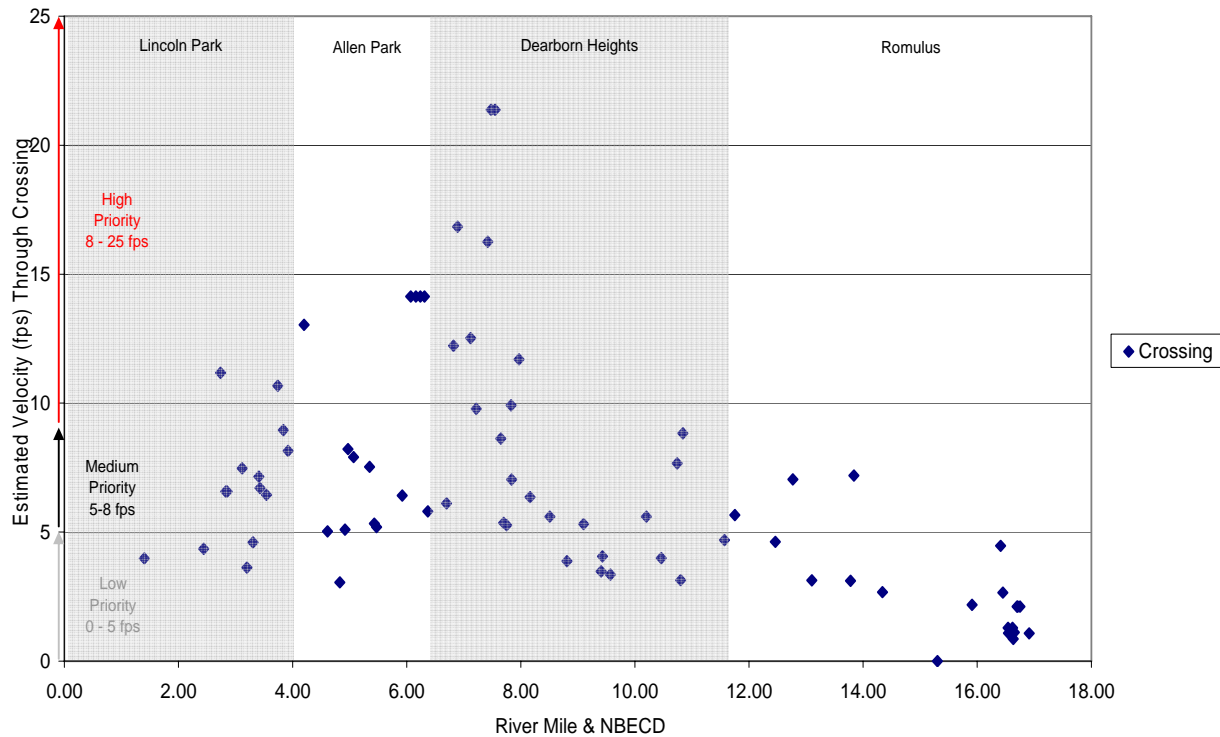
Initial screening shows the removal of drain crossings is considered to be a viable flood mitigation measure; however, from the analysis completed in Tasks 2 and 3, removal of drain crossings as a stand alone mitigation measure does not achieve flood mitigation.

The initial screening of the drain crossing replacements and allowed overtopping included the calculation of the water velocity through each crossing. The velocity was calculated by dividing the open waterway end area of each crossing by the 1948 design flow rates. The calculated velocities were categorized as: (a) less than five (5) feet per

second (fps) suggesting that the crossing is adequate to convey 1948 design flow rates; (b) five (5) to eight (8) fps suggesting the crossing is restrictive and undersized or (c) greater than eight (8) fps suggesting the crossing is grossly undersized.

Figure 4-4 shows the calculated velocities through each crossing using the 1948 design criteria. The analysis indicates that 49 percent of the crossings do not have the adequate waterway area to convey the 1948 design flows. A much higher percentage does not meet the present day criteria of the 10 year design storm. Based on this, it was determined that crossing improvements to increase conveyance capacity must be an integral part of any viable flood mitigation alternative.

**Figure 4-4
Initial Screening of Drain Crossing Velocity along NBECD
Using 1948 Design Flow Rates**



Crossings along county drains are not owned or maintained by the Drainage District, the Drain Commissioner or the WCDOE; therefore some crossings are subject to multiple jurisdictions and design requirements. For example, the design standard for conveyance set by the county Drain Commissioner may differ from the design standard of a crossing owner such as MDOT, road commission or municipality. The ownership of the drain crossings along the NBECD is summarized on Table 4-3. WCDOE sought input regarding jurisdictional design standards for drain crossings and identified whether overtopping of crossings or crossing removal was acceptable to them.

**Table 4-3
Initial Screening of Drain Crossing Improvement
Design Criteria Along the NBECD**

NO.	RIVER MILE	CROSSING NAME	OWNER	MINIMUM DESIGN STANDARD	OVERTOPPING ACCEPTED	CONSIDER POSSIBLE REMOVAL OF CROSSING
1	0.09	W. Jefferson Ave.	County	50 year	No	No
2a	0.22	Railroad Tracks	Railroad	100 year	No	No
2b	0.23	Railroad Tracks	Railroad	100 year	No	No
2c	0.24	Railroad Tracks	Railroad	100 year	No	No
2d	0.26	Railroad Tracks	Railroad	100 year	No	No
3	1.40	Southfield Rd.	County	50 year	No	No
4	2.44	Austin Ave.	Lincoln Park	10 year	Yes	No
5	2.74	Victoria Ave	Lincoln Park	10 year	Yes	Yes
6a	2.83	Fort St. (85)	MDOT	100 year	No	No
6b	2.85	Fort St. (85)	MDOT	100 year	No	No
7	3.12	Lafayette Blvd.	Lincoln Park	10 year	Yes	No
8	3.20	Fisher Fwy. (I-75)	MDOT	100 year	No	No
9	3.30	John Papalas Dr.	Lincoln Park	10 year	Yes	No
10	3.41	Railroad Tracks	Railroad	100 year	No	No
11	3.43	Private Drive	Private	10 year	Yes	No

**Table 4-3 (continued)
Initial Screening of Drain Crossing Improvement
Design Criteria Along the NBECD**

NO.	RIVER MILE	CROSSING NAME	OWNER	MINIMUM DESIGN STANDARD	OVERTOPPING ACCEPTED	CONSIDER POSSIBLE REMOVAL OF CROSSING
12	3.54	Porter Ave.	Lincoln Park	10 year	Yes	No
13	3.74	Dix Hwy.	County	50 year	No	No
14	3.84	Footbridge	Private	10 year	Yes	Yes
15	3.92	Frank Ave.	Lincoln Park	10 year	Yes	No
16	4.20	Stanley Ave.	Melvindale	10 year	Yes	Yes
17	4.61	Allen Rd.	County	50 year	No	No
18	4.83	City Park	Allen Park	10 year	Yes	No
19	4.92	Railroad	Railroad	100 year	No	No
20	4.97	Railroad	Railroad	100 year	No	No
21	5.07	Railroad	Railroad	100 year	No	No
22	5.35	Baker College	Private	10 year	Yes	Yes
23a	5.43	E. I-94	MDOT	100 year	No	No
23b	5.47	W. I-94	MDOT	100 year	No	No
24	5.92	Shenandoah Ave	Allen Park	10 year	Yes	No
25	6.07	Larme Ave./ Keppen Ave.	Allen Park	10 year	Yes	Yes
26	6.16	Russell Ave.	Allen Park	10 year	Yes	No
27	6.24	Watson Ave.	Allen Park	10 year	Yes	No
28	6.31	Euclid Ave.	Allen Park	10 year	Yes	Yes
29	6.37	Southfield Rd. (M-39)	MDOT	100 year	No	No
30	6.70	Bedford St.	Dearborn Heights	10 year	Yes	No
31	6.82	Edgewood St.	Dearborn Heights	10 year	Yes	Yes
32	6.89	Kingston St.	Dearborn Heights	10 year	Yes	No
33	7.12	Pelham St.	County	50 year	No	No
34	7.22	Jackson St.	Dearborn Heights	10 year	Yes	Yes
35	7.42	Hanover St.	Dearborn Heights	10 year	Yes	No
36	7.48	Hipp St.	Dearborn Heights	10 year	Yes	Yes
37	7.55	Polk St.	Dearborn Heights	10 year	Yes	Yes
38	7.65	Hanover St.	Dearborn Heights	10 year	Yes	No

**Table 4-3 (continued)
Initial Screening of Drain Crossing Improvement
Design Criteria Along the NBECD**

NO.	RIVER MILE	CROSSING NAME	OWNER	MINIMUM DESIGN STANDARD	OVERTOPPING ACCEPTED	CONSIDER POSSIBLE REMOVAL OF CROSSING
39	7.70	Harding Ave.	Dearborn Heights	10 year	Yes	No
40	7.75	Gertrude Ave.	Dearborn Heights	10 year	Yes	No
41	7.83	Campbell St.	Dearborn Heights	10 year	Yes	Yes
42	7.84	Hanover St.	Dearborn Heights	10 year	Yes	No
43	7.97	Williams St.	Dearborn Heights	10 year	Yes	No
45	8.16	Monroe St.	Dearborn Heights	50 year	No	No
46	8.51	Pardee Ave.	Dearborn Heights	10 year	Yes	No
47	8.81	Parker Ave.	Dearborn Heights	10 year	Yes	No
48	9.10	Madison Ave.	Dearborn Heights	10 year	Yes	No
49a	9.41	Telegraph Rd. North	MDOT	100 year	No	No
49b	9.43	Telegraph Rd. South	MDOT	100 year	No	No
50	9.57	Banner Ave.	Dearborn Heights	10 year	Yes	No
51	10.20	Gulley St.	Dearborn Heights	10 year	Yes	No
52	10.46	Beech Daly Rd.	County	50 year	No	No
53	10.74	Old Driveway	Private	10 year	Yes	Yes
54	10.80	Private Footbridge	Private	10 year	Yes	Yes
55	10.84	Bayham St.	Dearborn Heights	10 year	Yes	No
56	11.57	Inkster Rd.	County	50 year	No	No
57	11.75	Van Born Rd.	County	50 year	No	No
58	12.46	Beverly Rd.	Romulus	50 year	No	No
58b	12.77	Private Drive	Private	10 year	Yes	Yes
59	13.10	Ecorse Rd.	County	50 year	No	No
60	13.78	Middlebelt Rd.	County	50 year	No	No
61	13.84	Private Drive	Private	10 year	Yes	Yes
62	14.34	Smith Rd.	Romulus	10 year	Yes	No
63	15.30	Merriman Rd.	County	50 year	No	No
64	15.91	Venoy Rd.	Romulus	10 year	Yes	Yes
65	16.41	Henry Ruff Rd.	Romulus	10 year	Yes	Yes

Table 4-3 (continued)
Initial Screening of Drain Crossing Improvement
Design Criteria Along the NBECD

NO.	RIVER MILE	CROSSING NAME	OWNER	MINIMUM DESIGN STANDARD	OVERTOPPING ACCEPTED	CONSIDER POSSIBLE REMOVAL OF CROSSING
66	16.45	Sargent Rd.	Romulus	10 year	Yes	No
67	16.54	Private Drive	Private	10 year	Yes	No
68	16.55	Private Footbridge	Private	10 year	Yes	Yes
69	16.62	Private Drive	Private	10 year	Yes	No
70	16.63	Private Footbridge	Private	10 year	Yes	No
71	16.65	Private Drive	Private	10 year	Yes	No
72	16.70	Private Drive	Private	10 year	Yes	Yes
73	16.71	Private Drive	Private	10 year	Yes	No
74	16.75	Private Drive	Private	10 year	Yes	Yes
75	16.91	Ecorse Rd.	County	50 year	No	No

Storm Water Detention Facilities

Another potential mitigation measure is the addition of storm water detention facilities. Storm water detention facilities temporarily store or detain excess storm water and thus reduce peak flood flow rates. Currently there is no significant detention facilities directly connected to the NBECD. There are several facilities in the LeBlanc Drain but they do not directly connect to the NBECD and do not provide flood relief for the middle and upper reaches of the NBECD.

The addition of sufficient detention can reduce the magnitude of channel and crossing improvements needed to mitigate flooding. Thus, adding storm water detention sites could potentially reduce the land acquisition needed for channel improvements along the

stream corridor; however, to accomplish this, significant land acquisition for the storm water detention facilities would be required.

WCDOE, the consultant team and the Technical Committee developed a list of potential locations for regional storm water detention facilities. The list was then updated with input from the Policy Committee. The potential locations are shown as Table 4-4 and Figure 4- 5.

The storm water detention sites were initially prioritized based on geometrical criteria such as the location of the site (the sites closer to NBECD were prioritized higher), the ground elevation of the site (the sites with lower elevations were prioritized higher), and size of the site (larger sites were prioritized higher). The prioritization was completed to identify sites that would, from an engineering and construction point of view, be most effective and most efficient.

Table 4-4 summarizes the detention sites that were identified in the screening process and prioritizes the sites using the initial screening criteria.

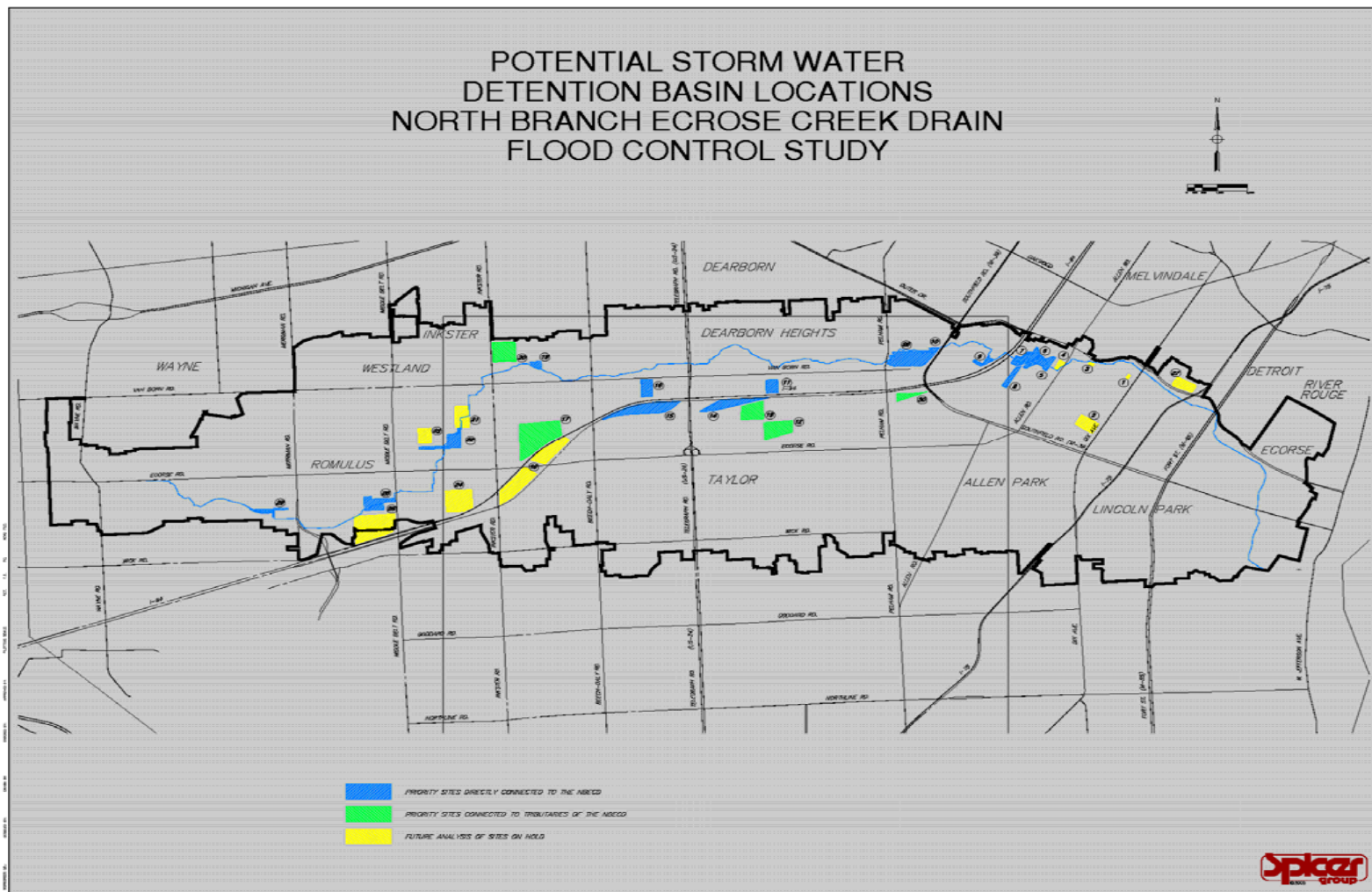
**Table 4-4
Potential Detention Basin Locations**

SITE NO.	SITE NAME	APPROXIMATE LOCATION	COMMUNITY
28	Southeast Dearborn Heights Area	N.W. of I-94/M-39 Interchange	Dearborn Heights
10	City Park	Raymond and Southfield	Dearborn Heights
22	Romulus Area 2	South of Beverly & West of Inkster	Romulus
29	Romulus Area 7 N.W. Smith Road / Merriman	N.W. of Smith Road and Merriman Road	Romulus
8	Enterprise Drive Area	Enterprise Drive and Norfolk & Western Railroad	Allen Park
7	Baker College Area	I-94 and Grand Trunk Railroad	Allen Park
6	St. Mary Magdalene Playfield Area	Grand Trunk and Norfolk & Western Railroad	Allen Park
5	Intercity Baptist Playfield/Mead School	Quandt and Hanford	Allen Park
9	Kennedy Park	Shenandoah and I-94	Allen Park
26	Romulus Area 6	South of Smith & North of Middlebelt	Romulus
11	Go Cart / Mini Golf Site	Van Born and Clippert	Taylor
16	Closed Drive In Site	Van Born and Westlake	Taylor
15	MDOT Median Area 2	I-94 and Banner	Taylor
14	MDOT Median Area 1	I-94 and Monroe	Taylor
19	Lukas Storm Drain Outlet	Powers and John Daly	Dearborn Heights
20	Sanitation Authority	Inkster and Powers	Dearborn Heights
24	Romulus Area 4	I-94 and Smith	Romulus
25	Romulus Area 5	North of Smith & East of Merriman	Romulus
30	MDOT ROW Area	I-94 and Southfield Fwy.	Taylor
12	German Drain Area 1	Monroe Ave and Norfolk & Western Railroad	Taylor
13	German Drain Area 2	Pardee and I-94	Taylor
17	Beverly Site	Beverly and Holland	Taylor
21	Romulus Area 1	North of Beverly & West of Inkster	Romulus
4	Thunder Bowl Parking Lot	Allen and College	Allen Park
27	Ford Glass Plant	South side of Outer Drive near I-75	Lincoln Park
3	Saint Stephens Church Yard	Laurence and Morris	Allen Park

**Table 4-4 (continued)
Potential Detention Basin Locations**

SITE NO.	SITE NAME	APPROXIMATE LOCATION	COMMUNITY
23	Romulus Area 3	South of Beverly & West of Inkster	Romulus
18	MDOT Median Area 3	I-94 and Ecorse	Taylor
2	Quandt Park	O'Connor and Dix	Lincoln Park
1	Finlay School Yard	Dix & Olive	Lincoln Park
High	Sites to have detailed analysis including development of stage storage relationships input into model, and possibly environmental reviews.		
Medium	Sites to be considered for detention on tributary drains and evaluated for impacts on NBECD by reducing flows from tributary drains.		
Low	Further analysis of these sites currently on hold.		

**Figure 4-5
Potential Storm Water Detention Sites Identified in NBECD Drainage District**



Preliminary modeling of storm water detention was completed. The preliminary analysis assumed detention sites that are rated high were in place and had sufficient unlimited storage capacity. The results of the analysis identified that storm water detention alone, without channel or crossing improvements is not a viable option, primarily because there is not adequate conveyance capacity in the existing NBECD between the identified sites. Thus, flood flows can not be conveyed between the sites without exceeding the channel banks and flooding. In summary, a storm water detention intensive flood mitigation alternative is only viable if combined with channel and crossing improvements.

Upon initial prioritization of the sites, others factors such as land acquisition impacts, environmental impacts, social impacts, cost effectiveness, and input from the Policy Committee were considered resulting in a change to the prioritization of several sites. Detailed analysis of combinations of potential sites was completed in Task 5 and 6. Additional analysis of potential sites and incorporation of these sites into flood mitigation alternatives is provided in Tasks 5 and 6.

Diversions/Drainage Transfers

Several mitigation measures related to diversions or drainage transfers were identified.

These include:

- Divert NBECD to Rouge River along I-94
- Divert LeBlanc Drain to NBECD at Monroe Street
- Divert Reeck Drain to NBECD at Monroe Street

- Allow overflow of NBECD to the City of Dearborn storm sewers
- Divert NBECD to Huron River

As previously mentioned, diversion to the Huron River and allowance of the NBECD to overflow the City of Dearborn were eliminated as potential mitigation measures as they are not accepted locally as viable measures.

LeBlanc Drain and Reeck Drain Diversion

Under existing conditions, there is a large relief storm sewer under Monroe Street that was previously constructed with the intent of diverting storm water from the LeBlanc Drain to the NBECD. A schematic of the Monroe Street relief sewer and additional detail is provided in the Task 2 report. Since this relief sewer is in place, efficient utilization of the sewer would be cost effective and therefore preliminary analysis of utilizing the relief sewer was completed. Diversion schematic of the Leblanc and Reeck Drains into the relief storm sewer at Monroe Street was investigated.

The relief sewer was originally constructed in anticipation of the NBECD being improved shortly thereafter; however, improvements to the NBECD were never completed. As a result, the NBECD is currently not an adequate outlet for the Monroe Street relief sewer (from the LeBlanc Drain). To mitigate flooding in the LeBlanc Drain, the City of Taylor constructed several large storm water detention facilities after the installation of the Monroe Street storm sewer. This mitigated flooding along the Leblanc Drain without having to divert flood flows to the NBECD. The Monroe Street relief

sewer was then bulk headed near I-94 and currently the Monroe Street relief sewer, south of I-94, overflows into the Monroe Street storm water detention basin and does not flow into the NBECD.

Upon a preliminary review of elevations, flow patterns and existing infrastructure, it was identified that the bulkhead in the Monroe Street relief sewer should be maintained and that a diversion or inter-connection of the LeBlanc Drain and NBECD at Monroe Street is not a viable mitigation measure. Several reasons for this are (a) storm water detention infrastructure is already in place in Taylor, (b) the inter-connection brings a possibility of introducing additional flood water from the NBECD into the LeBlanc Drain and (c) if water from LeBlanc Drain is successfully diverted to NBECD, the NBECD channel and crossing sizes must be increased in downstream reaches to accommodate additional flood flows from LeBlanc Drain. This last item does not make sense since the City of Taylor has indicated that they have achieved reasonable flood mitigation in the LeBlanc Drain south of I-94.

The diversion of the Reeck Drain into the Monroe Street relief storm sewer to assist in flood mitigation along the Reeck Drain and the NBECD was determined to be a viable mitigation measure. Primarily because (a) the upper portions of the Reeck Drain are currently diverted to the NBECD via the section of the Monroe Street relief sewer located north of I-94 and the bulkhead, (b) the drainage area being diverted is relatively small, and (c) during flood flow conditions water overflows Van Born Road between the Reeck Drain and the NBECD. The overflows result in discharge to the NBECD with or without

the presence of the Monroe Street relief sewer diversion of the Reeck Drain. The Reeck Drain diversion and the Reeck Drain detailed analysis are provided in Tasks 5 and 6.

Diversion to Rouge River Via Open Channel

The initial reason for diversion to the Rouge River as a potential mitigation measure was that it was speculated that the concrete channel of the Rouge River had excess flow capacity and that this might be a cost effective solution. Diverting the flood flows of the NBECD to the Rouge River along the I-94 could reduce the need for large scale channel, crossing and storm water detention improvements in the lower reach of the NBECD.

Preliminary engineering analysis and coordination with MDOT was completed and it was identified that an open channel diversion along the I-94 corridor is not a viable option.

The primary reasons for this include (a) the open channel geometry required to convey flood flows from the NBECD could not fit within the I-94 corridor without compromising MDOT traffic safety requirements, (b) placement of open channel in this corridor would restrict potential future improvements of I-94 to increase traffic capacity, and (c) placement of an open channel diversion outside of the I-94 corridor would require substantial acquisition of structures that are not currently impacted by the NBECD.

Other concerns include conflicts with existing infrastructure and regulatory concerns regarding the impacts on the Rouge River.

Storm Water Tunnels

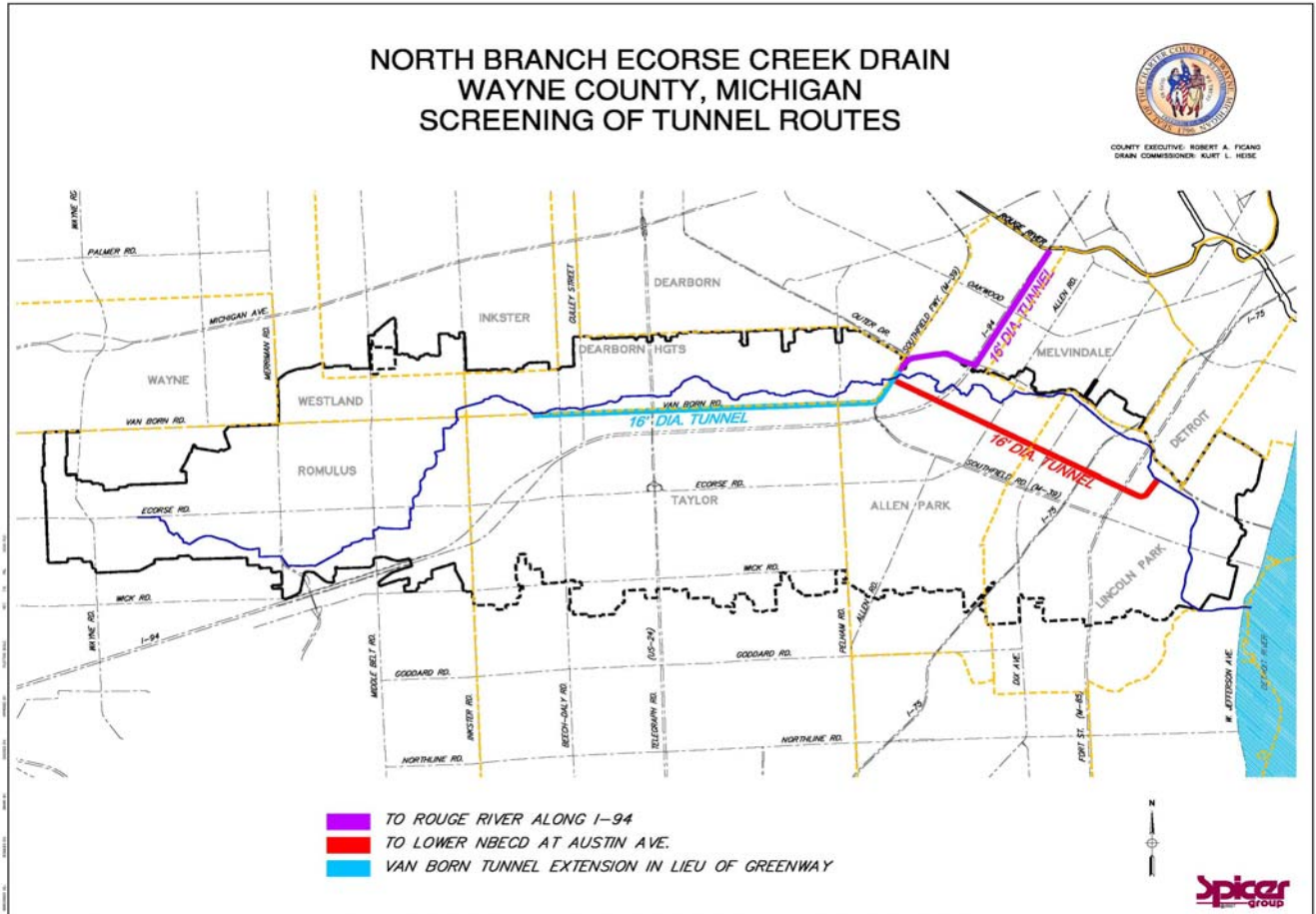
Storm water tunnels were identified as potential mitigation measures. The initial idea was that the tunnels would minimize channel, crossing, and detention improvements and reduce disturbance to landowners and residents that would be realized with the construction of open channel improvements. The WCDOE, consultant team and Technical Committee identified three conceptual tunnel alternatives:

1. Tunnel to the Rouge River (I-94 alignment)
2. Tunnel along Van Born Road from Gully Street to Southfield Freeway (Van Born alignment)
3. Tunnel to the lower NBECD from Southfield Freeway to Austin Avenue (Southfield alignment)

With input from the Policy Committee, tunnel alternatives were considered to be a viable mitigation measure and a detailed analysis of flood mitigation alternatives that include tunnels is provided in Tasks 5 and 6.

For initial screening of tunnels alternatives, NTH Consultants, Ltd. (NTH) of the consultant team completed a preliminary analysis to provide opinion on the feasibility of constructing tunnels and potential alignment of tunnels. A copy of the Preliminary Tunnel Alternative Geotechnical Evaluation Report is included in Appendix A. The report concluded that the three tentative tunnel alignments shown in Figure 4-6 are feasible to construct.

**Figure 4-6
Screening of Tunnel Routes**



Construction of tunnels is not a cost effective mitigation measure when compared with construction costs of open channel improvements; however, the potential of reducing land acquisitions and having a low impact project was appealing to the Policy Committee and WCDOE and thus warranted detailed analysis.

Preliminary analysis concluded that the addition of tunnels as a mitigation measure would not completely eliminate the need for channel and crossing improvements, however it would substantially reduce the magnitude of the needed improvements. With the tunnel,

similar to storm water detention basins, the storm water must be adequately conveyed to the intake locations where overflows enter into the tunnel. It was identified that without channel and crossing improvements, out of channel flow and flooding would occur in between tunnel intake locations.

Floodplain Management

Several mitigation measure ideas regarding floodplain management were identified.

These include:

- Acquire undeveloped lands in floodplain/create new floodplain
- Acquisition of flood prone structures
- Install vegetative and wetland buffers along drain corridor

Acquire Existing Undeveloped Lands in Floodplain

Initial screening of the potential mitigation measure of acquiring undeveloped lands in the floodplain as a stand alone measure cannot achieve flood mitigation. The mitigation measure is consistent with the goals of the flood control and is recommended but was determined as non-viable on large scale. Additional detailed analysis of this measure was not completed. Primary reasons for this are (a) the undeveloped lands (sites) currently in the floodplain were also identified as potential storm water detention sites and thus are being evaluated with storm water detention flood mitigation alternatives, (b) current statutes and regulations outline requirements for development and development can be pursued if the landowner desires, and (c) to ensure development does not occur the

drainage district must finance and purchase the properties and this occurs the sites would most likely be used for regional detention facilities.

Acquisition of Flood Prone Structures

Acquisition of flood prone structures is a viable mitigation measure as long as it is needed for the implementation of other mitigation measures such as channel, crossing or storm water detention improvements. In short, acquisition is a necessary component of any viable flood mitigation project.

However, acquisition of all flood prone structures within the drainage district's floodplain was identified as not acceptable locally and is a non-viable mitigation measure. There are too many structures located within the floodplain and acquisition would decimate the communities' population.

Vegetative and Wetland Buffers

Installation of vegetative and wetland buffer strips and creation of new floodplain storage are viable mitigation measures. These measures have been considered to be items in the final engineering design and therefore were not analyzed in great detail as part of the flood control study. The magnitude of vegetative and wetland buffer strips and the creation of new floodplain storage is directly related to the amount of the available drain right of way. For example, the greenway channel mitigation measure would create additional flood plain storage and would involve large scale land acquisition along the

NBECD corridor thus providing sufficient right of way to incorporate vegetative and wetland buffers.

Preliminary Environmental Assessment

A preliminary environmental assessment of potential detention sites and the NBECD corridor was completed to provide a general understanding of potential environmental impacts and regulatory requirements and sediment contamination. Environmental Consulting and Technology, Inc. (ECT) of the consultant team completed the North Branch Ecorse Creek Drain Flood Control Preliminary Environmental Review memorandum which is located in Appendix B. This memorandum presents in detail the preliminary environmental assessment.

The preliminary assessment was limited to research of environmental records, review of aerial photography and various maps, a “windshield” field review of the site, and testing of four (4) sediment samples from the lower NBECD near the Detroit River. The preliminary assessment included a review of the following:

- Wetlands
- Soils
- Woodlands
- Lakes, streams and flood plains
- Threatened or endangered species
- Archeological or historical sites
- Sites of environmental contamination

- Sediment sampling and testing
- Related state and federal regulations and permit

The following paragraphs provide a brief summary of the preliminary environmental assessment, additional detail is provided in Appendix B.

Wetlands

In general, the NBECD corridor and potential storm water detention sites do not contain substantial wetlands or high quality wetlands based on the National Wetland Inventory (NWI). The NWI does not show wetlands in these areas. General reviews of NBECD conclude, however, that small areas of less than 5 acres each of scattered low quality wetlands exist at various locations along the NBECD and may exist at potential detention sites 5, 6, 7, 8, 11, 20b, and 22. In accordance with the Michigan Wetland Act (Part 303 of Public Act 451 of 1996), several of the wetlands are regulated and wetland mitigation may be required. Wetland mitigation was not evaluated in detail as part of the flood control study and it was assumed that mitigation efforts could be implemented within the right of way limits of the flood control project.

The potential flood mitigation measures to be incorporated in the flood control project may impact wetland mitigation requirements. Mitigation measures, such as a greenway channel that will promote a continuous corridor along the NBECD, could feature the construction of small pockets of adjacent wetland and enhance wetland habitat along the NBECD.

Woodlands

The viable flood control project will impact adjacent woodlands requiring large scale removal of trees in the NBECD channel. Tree removal at potential storm water detention sites may also be required if this is a selected mitigation measure. The Cities of Allen Park, Dearborn Heights, and Romulus have tree ordinances. The mitigation measures needed to be compliant with these ordinances were not evaluated in detail in the flood control study and variances for the implementation flood control project may be pursued.

Lakes, Streams and Floodplains

There are no lakes along the NBECD corridor or the potential storm water detention sites. The NBECD meets the definition of a regulated stream in accordance with Michigan Inland Lakes and Streams Act (Part 301 of Public Act 451 of 1996). Depending on the selected mitigation measures, improvements to the channel may or may not be regulated. Section 30103(g) provides for some exemptions for maintenance and improvement to county drains completed in accordance with Chapter 8 of the Michigan Drain Code (Public Act 40 of 1956). Channel mitigation measures, (including the greenway channel) that require significant widening of the channel and diversions, (including the potential diversion to the Rouge River) will require permits. WCDOE has had several meetings with MDEQ and it has been generally concluded that a greenway channel and associated drain crossing improvements would be a permitted activity.

The potential mitigation measures of diverting the NBECD to the Rouge River and the tunnel alternatives, however, were not a favorable alternative with the MDEQ. The

addition of storm water detention basins would also be regulated in accordance with Inland Lakes and Streams. It was generally concluded that this would be a permitted activity.

The United States Army Corp of Engineers (USACE) also regulates activities on navigable waters which includes the lower portions on the NBECD. The USACE has attended Policy and Technical Committee meetings and the WCDOE has met with the USACE regarding the flood control project and possible funding through USACE. It was generally concluded from these meetings that dredging of the lower portions of the NBECD would be permitted by USACE.

Some potential flood mitigation measures are within the 100 year flood plain and therefore regulated in accordance with Part 31 of Public Act 451 of 1996. Spoils (excavated soil) from potential channel and crossing improvements completed within the existing 100 year floodplain of the NBECD are planned to be hauled to an appropriate off-site disposal location, thus filling of the flood plain will not occur. In the upper portions of the NBECD, the drain traverses through agricultural land. In these areas, spoils have been considered for disposal and leveling along the drain right of way. The potential channel improvements for these areas do not include significant widening and therefore, the volume of spoils is relatively small. The extent of potential improvements in these reaches may be considered maintenance and improvement activities in accordance with Chapter 8 of the Drain Code.

Potential storm water detention mitigation measures located within the 100 year flood plain are regulated as well. Detailed analysis of spoil deposition for each potential site has not been completed as part of the flood control study. It was assumed, however, that the excess spoils from several of the potential sites would be leveled on-site and potentially in the 100 year flood plain. If storm water detention facilities are incorporated in the flood control project, this activity must be coordinated and permitted with MDEQ.

Threatened or Endangered Species

Threatened and endangered species are regulated by the Endangered Species Act (Part 365 of Public Act 451 of 1996). A threatened and endangered species inquiry was submitted to the Michigan Department of Natural Resources. The response to this inquiry showed the possibility of an endangered species, the three-awned grass (*Aristida longespica*) in potential work areas. The three-awned grass is an annual plant species and prefers to grow in dry, sandy ground in fields, clearings, and prairies. It is not known at this time if this species is present along the NBECD corridor or potential detention sites. Past records indicated the possibility of the species to be located in Section 27, T25S, R10E. The preferred habitat of the species along the NBECD corridor is sparse. A detailed review and analysis has not been completed as part of the flood control study and must be completed in future phases once the scope of the flood control project is selected. If the species is found, modification to final design may be required.

Archeological or Historical Sites

A review of archeological and historical sites was performed along the NBECD corridor and the potential detention sites. According to John Halsey, the State Archeologist, records show that there are 18 known archeological sites in the NBECD area in Wayne County; however, none of the sites are in direct proximity of the NBECD corridor or potential detention sites. The State Archeologist indicated that a detailed review in accordance with the Section 106 of the National Historic Preservation Act of 1966 should be completed. This was not completed in the flood control study.

Sites of Environmental Contamination and Sediment Contamination

A preliminary review including environmental database query and “windshield” field observations were performed on portions of the NBECD corridor and several potential storm water detention sites to identify the possibility of soil/groundwater contamination. The potential storm water detention basin sites identified with likely contamination were sites 17, 20, and 22. Also, the City of Taylor indicates that sites 12 and 13 have contamination as well. ECT was not asked to evaluate these sites; therefore, they are not mentioned in the preliminary environmental assessment memorandum. If these sites are included in the flood mitigation project, remediation is expected. A detailed analysis of this has not been completed as part of the flood control study.

There are several known sites of contamination along the NBECD corridor, many of them being leaking underground storage tanks. A complete summary of all areas identified can be found in the report located in Appendix B. It has been anticipated that

spoils from contaminated sites generated upon the implementation of the flood control project must be disposed of at a landfill or appropriate disposal site. A detail analysis of contamination levels or spoil deposition methods was not completed as part of the flood control study. At the time of the flood control study, estimates for Type II land fill tipping fees were obtained and incorporated into the estimates of cost provided in Task 6. Land fill tipping fees may be subject to changes based on state requirements.

Four (4) sediment samples were collected in the lower reach of the NBECD downstream of Fort Street. Results of sediment sample are provided in detail in Appendix B. In general, test results indicated that contamination levels exceeded state limits and sediment dredged or excavated must be disposed of in a Type II land fill or appropriate disposal site with a restrictive covenant.

Task 5 provides initial modeling and evaluation of flood mitigation alternatives that were developed using acceptable mitigation measures outlined in Task 4.